

SOURCES OF INNOVATION IN DAIRY PRODUCTION IN KENYA

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In times of market liberalization and structural adjustment, the agricultural sectors of developing countries face profound changes. To seize new market opportunities, farmers need to innovate—to become more efficient producers and effective entrepreneurs. In order to innovate, farmers need new technologies and information on how to access and manage them, as well as better support services for the delivery of inputs and knowledge, and better infrastructure for delivering produce to the market. Structural adjustment policies, however, have led to sharp reductions in public-sector research and extension services, on which farmers have come to rely as their principal sources of innovation. Can the private sector step in to provide these services? Is there a continuing role for public-sector actors? And, if so, how will private- and public-sector players interact?

This Briefing Paper presents a case study of a dairy production venture in Kenya that sheds light on these questions. Kenya's dairy subsector is already changing: a buoyant market for dairy products offers producers an opportunity to increase their income and an incentive to invest in new technologies; in response, market-oriented institutions are evolving and private-sector service providers are stepping into the arena. But market development is more advanced in some areas than in others, providing an opportunity to gain insights into the process of change by comparing more- and less-developed areas.

Background: Analyzing Innovation in Agriculture

The study set out to test the assumption that, under the policies of structural adjustment and market liberalization, the development of markets increasingly determines the institutional environment for agricultural production and innovation. In particular, the degree of market access also affects farmers' opportunities to access new technologies and information.

Agriculture in general, and dairy production in particular, is both knowledge- and technology-intensive. Farmers every-

where, whether they are herding livestock according to traditional practice or using modern biotechnology, rely on an extensive network of people, institutions, and organizations that constitute their knowledge base and source of technologies. However, farmers in developing countries especially are currently experiencing a fundamental shift in the components of this knowledge base (Meijerink and Liang 2000). As they move from subsistence to market-oriented production, they are adapting from reliance on a publicly funded research and exten-



sion system alone to involvement with a more diverse set of actors, including private-sector agents. The key question addressed by this paper is whether these new actors alter the quantity and quality of the services available to farmers. Can private-sector actors replace public-sector ones, or should they merely be expected to complement them?

The driving forces of innovation can be found in three different spheres: in the entrepreneurial characteristics of producers, in the economic forces of input and output markets, and in the opportunities arising from research. Entrepreneurial producers are characterized by their curiosity, their willingness to experiment and to take risks, and their “business-mindedness”—evident in the way they deliberately search for improvements and opportunities. From an economist’s point of view, it is market forces that drive innovation. The relative costs of the different factors that feed into production—especially land, labor, and capital—reflect their degree of scarcity, such that producers will always demand technologies that economize on the use of the scarcest and most expensive factor. In turn, the relative prices of different agricultural commodities, which partly reflect these costs, influence the amount of each commodity that is produced, processed, and traded (Ruttan 1997; Sundbo 1995). And, on the technical side, improvements resulting from basic and adaptive research—often publicly funded or coordinated—can become a motor of innovation in agricultural production (e.g., Biggs 1990). Most authors (e.g., Dosi 1988) see a combination of these spheres, rather than any single overriding one, as providing the impetus for innovation.

Dairy production often provides striking examples of the process of innovation at work. Access to rapidly expanding urban markets for milk and other dairy products provides farmers with opportunities to intensify their production (Roseboom 1998) by taking advantage of new technologies and services, such as artificial insemination (AI), veterinary health care, and milk collection. Especially in the early stages of market development, the process of institutional change can be rapid and wide-ranging, as these technologies and services become available and as farmers organize themselves to access and use them. The nature of this transition to a market-oriented system depends largely on the political and economic

incentives for private investors to participate and on official policy towards the continuing involvement of the public sector. Even in a system driven by market forces, public-sector actors can still play an important role in conducting research that generates public goods. And not only can they, but they must provide an appropriate policy environment that stimulates private-sector innovation and development while protecting the interests of the public, and especially the poor, through appropriate regulatory activities.

Although decisions on whether and how to innovate ultimately rest with farmers, other individuals and organizations provide farmers with the necessary information and technology to support their decisions, thereby constituting “sources of innovation” for them. These actors can be classified as belonging to the social, economic, or public domains. Family, friends, neighboring farmers, and other social contacts constitute the social domain. The economic domain includes actors involved in market transactions with farmers, such as input manufacturers and suppliers, marketing agents, processors, and consumers. The public domain includes governmental institutions, such as ministries, and public-sector organizations, such as research institutes. Actors in the public domain are involved in policy making and the provision of a wide range of services, such as research, extension, breeding, disease prevention, and marketing. In practice, however, market development tends to blur these distinctions, as private-sector entities increasingly take on what have traditionally been public-sector functions, and as entities that had their origin in the social domain—for instance as self-help farmer groups—become more market-oriented and evolve, for example, into organized cooperatives.

Similarly, it is difficult to classify the various actors in the agricultural innovation system. They can be inventors, generating knowledge and technology; they can constitute a knowledge base; or they can serve as a channel for information. A particular actor can play more than one role. In this case study, a distinction is drawn between dairy farmers, who are considered to be the users of innovation, and “network actors,” comprising all the other members of the innovation support system. However, it is important to bear in mind that dairy farmers can be innovators too, and can serve as part of the knowledge base of other farmers or as a communication channel to them.

Dairy Production in Kenya: A Case Study in Innovation

Historical perspective

Kenya has a long history of dairy farming, and the dairy subsector has always been a priority for policy makers. Under the colonial government, a comprehensive infrastructure to support dairy farming was built up, primarily in high-potential areas and particularly in the “White Highlands,” where the large-scale production units were predominantly owned by European settlers. Soon after Kenyan independence in 1963, the government accorded high priority to the smallholder dairy subsector and, during the 1970s and 1980s, most of the White Highlands were resettled by smallholders under the Million Acre Settlement Scheme. As the number of registered smallholders increased, the public-sector research and extension services, along with parastatal marketing and veterinary services, developed to support them. Market liberalization and the privatization of services in the dairy sector started in the early 1990s, as part of the general liberalization of the economy and the structural adjustment program promoted by the World Bank and the International Monetary Fund. Government policy supported the process, which led to the establishment of a number of commercial businesses. At the same time, budgets for public-sector agricultural services were sharply reduced.

Two contrasting areas

To gain insights into how the process of innovation in dairy production is affected by market liberalization, the research team interviewed dairy farmers and network actors in two contrasting districts of Kenya: Kiambu and Nyandarua. These districts were

selected to represent, respectively, an area with advanced market development close to a major urban center (Nairobi) and a remoter area with poorer access to markets.

The perceptions of farmers and network actors were captured through semi-structured interviews based on two different questionnaires. Farmers were asked what innovations they had introduced in their dairy operations and where they had obtained the necessary information, assistance, and materials. The network actors, which included researchers, extension agents, veterinarians, were asked what types of service they provided to farmers and how they assisted them in improving their dairy operations; they were also asked where they obtained information and new technology—to identify “second-level” innovation sources. A total of 58 farmers and 41 network actors participated in the surveys, which were conducted in November 2000.

Table 1 provides details of the farmers interviewed and the characteristics of their farms. To find out whether the scale of operation influenced the innovation process, a distinction was drawn between small- and large-scale dairy farms. Those with a herd of 10 or more animals (even though the actual number of milking cows was often lower) were classified as large-scale. Care was taken to include women farmers.

Kiambu district is in a highly productive and densely populated part of the highlands. Dairy production is carried out both on small family farms (those in the survey averaged 4.5 acres), using intensive stall-fed (“zero-grazing”) systems, and on large, profession-

Table 1: Overview of farmers interviewed and farm characteristics

	Kiambu				Nyandarua			
	No. of farmers interviewed	Average farm size (acres)	Average herd size	Average no. of milking cows	No. of farmers interviewed	Average farm size (acres)	Average herd size	Average no. of milking cows
Small-scale farmers (herd size < 10)	12	4.5	5.5	2.5	10	20.0	4.0	2.0
Large-scale farmers (herd size > 10)	5	163.0	111.0	40.0	4	75.5	33.0	11.5

Note: 1 acre = 0.405 hectare.

ally operated enterprises (average size: 163 acres). These rely largely on grazing, with some supplementary feeding of concentrates. With an average distance of 20 km from the farm gate to Nairobi, infrastructure and market access in Kiambu are comparatively good, and the milk prices received by farmers are relatively high.

The district of Nyandarua is about 150 km from Nairobi in the Rift Valley, where the climate and environment are less favorable for dairy production. Population is less dense than in Kiambu. Small-scale dairy farmers have larger farms (on average, 20 acres) but a slightly smaller herd. Both large- and small-scale producers rely mainly on grazing to feed their cattle, with some seasonal supplementation. Access to the Nairobi market is limited not only by the greater distance and poorer infrastructure, but also because the private sector is less well developed. Consequently, producer prices for milk are significantly lower.

The influence of the natural and economic environment

During the interviews, the farmers were asked to identify all the changes they had made to improve their dairy operation during the previous five years (1995–2000).

Figure 1 shows the percentage of farmers in Kiambu and Nyandarua who reported a major improvement in different areas of innovation.

The figure shows a clear difference in the types of innovation chosen by dairy farmers in the two districts. In Kiambu, the majority have adopted AI

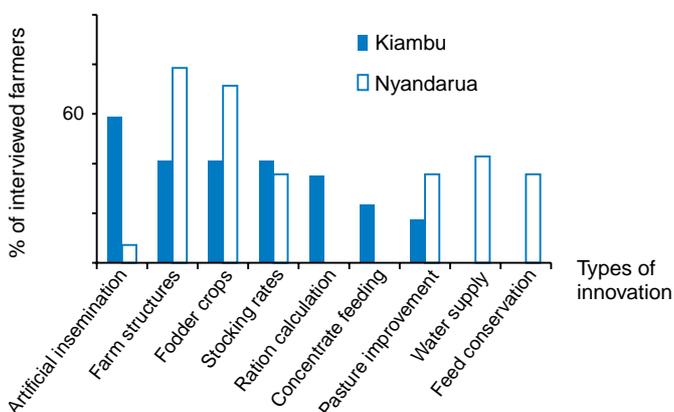


Figure 1: Adoption of different kinds of innovation by dairy farmers in Kiambu and Nyandarua Districts (1995–2000)

and so have introduced improved dairy breeds. A substantial minority have also introduced new protein-rich fodder crops and methods of calculating rations, reduced their stocking rates (resulting in a further specialization in milk production), started purchasing concentrate feeds, and improved their farm structures (for example, by installing and maintaining feeding stalls). The majority of farmers in Nyandarua, in contrast, have emphasized the improvement of farm structures and the adoption of fodder crops, while substantial minorities have taken steps to secure water supplies, improve pastures, conserve feed, and reduce stocking rates.

In Nyandarua, the demand for improved pasture and fodder crops, water supply, and feed conservation technology reflects the constraints still imposed on dairy production by the natural environment. At present, farmers have only limited control over this environment, leading to seasonal fluctuations in the availability and quality of feed. Farmers are trying to overcome these constraints by improving their farm structures (such as stables, sheds, roofs, and troughs), reflecting a shift from grazing to at least some stall-feeding—a step already taken long ago in Kiambu.

More advanced technologies such as AI, ration calculation and concentrate feeding are much more common in Kiambu than in Nyandarua, indicating that the greater degree of market integration and the higher prices paid to producers in Kiambu justify investments in performance-improving technologies. In the case of AI, for example, farmers in Nyandarua mentioned a number of reasons why they are unready or unable to adopt the technology: they lack information on its advantages; the services are not easily available; and milk prices, and thus their incomes, do not allow such an investment. In some ways, the situation in Nyandarua can be seen as a vicious circle where distance to market, an unfavorable environment, and poor infrastructure prevent markets and services from developing, while in Kiambu a virtuous circle of higher incomes, more investment, and better services is well established.

Two tentative conclusions can be drawn. First, the options for innovation that are open to farmers, in the sense of being appropriate for them, are determined primarily by the local natural resource base and the local institutional context (including variables such as land ownership and land-use systems). Second, these options are then modified by the availability and affordability of information and services. Although

this is not explicit in the survey results, differences in the relative values of key factors and inputs—land and feed, for example—in the two districts have evidently played a role in determining the type of innovation chosen by farmers. Kiambu shows higher adoption rates for more advanced, performance-improving technologies that reduce the demand for land—the scarce factor.

The effect of market development on information and technology flows

The farmers were also asked from which actors they obtain information, inputs, services, and technologies in six service categories: extension, marketing, credit, feed supply, AI and semen supply, and veterinary services and drug supply. The researchers did not provide a list of actors to prompt farmers, and farmers were free to identify the same actor as providing more than one category of service.

It is evident from their responses (figure 2) that farmers in Kiambu and Nyandarua depend on a quite different spectrum of actors. In Kiambu, market-oriented actors—cooperatives and private companies—are the farmers’ most important sources of innovation. The key role of the cooperatives can be attributed to the broad range of services they provide to their members. The cooperatives serve as mediators between farmers and the competitive market and are correspondingly highly valued not only as sources of innovation, but also as marketing channels. Nevertheless, private companies are gaining in influence, especially those that combine teaching and extension with marketing their particular product or service. In Nyandarua, strictly market-oriented actors are less important, particularly in the case of private compa-

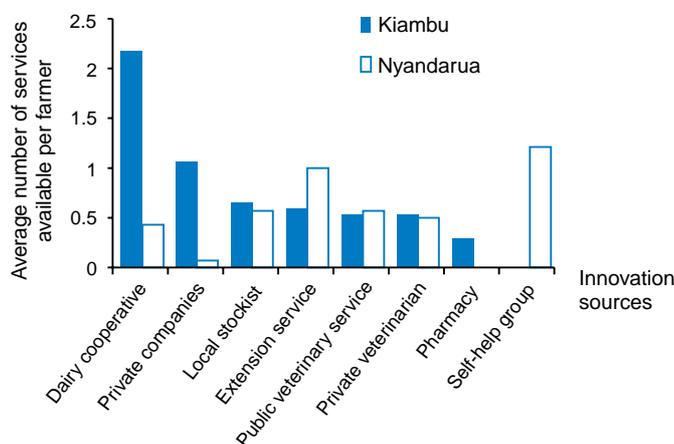


Figure 2: Importance of various innovation sources to farmers in Kiambu and Nyandarua

nies, of which there are very few. Despite the declining role of public-sector actors, extension and veterinary services are still important to farmers. Self-help groups emerge as the most important sources of innovation. Such groups are a useful forum for information exchange among farmers, but their role in terms of providing access to services is often limited, because the services that farmers would like to receive are either not available or are too expensive.

The role of the public sector

Does the growing importance of the market in agricultural innovation imply that public-sector intervention is no longer needed? In the previous section the contribution of different actors was evaluated from the farmers’ perspective. Interestingly, the picture looks very different when the question of innovation sources is raised with the network actors whom farmers identified as information providers. These “second-level” sources of innovation may be “invisible” to the farmers but may still play a vital role in meeting their needs.

Figure 3 shows how the network actors rated the relative importance of various second-level sources of innovation. Here the actors who were not mentioned by the farmers—in particular the Ministry of Agricultural and Rural Development (MoARD) and public-sector research institutions—become very influential, while others, such as cooperatives, self-help groups, and smaller private businesses, no longer appear.

Network actors identified the MoARD as the most important second-level innovation source. This probably reflects their increasing awareness of the impact of public policy on agricultural innovation. Many interviewees, for example, thought that MoARD policymakers needed to improve the infra-

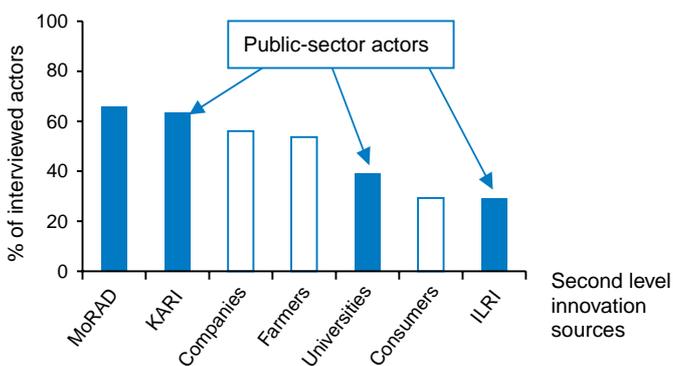


Figure 3: Second-level innovation sources

structure and institutions that support the agricultural sector. However, respondents also recognized the value, as a local knowledge base, of the MoARD's extension service, which has traditionally acted as the main channel through which the information and adapted technologies generated by public-sector research have reached farmers. Network actors also mentioned various research organizations, including the Kenyan Agricultural Research Institute (KARI), the International Livestock Research Institute (ILRI), and a number of Kenyan universities, as key sources of innovation.

The perceptions of network actors thus form a striking contrast with those of farmers. Although

farmers have less and less direct contact with extension officers, and very few of them identified research institutions as sources of innovation, the network actors who are now the principal sources of information for farmers all recognize their dependence on the public-sector research and extension services. Interestingly, this is also true for actors in the market domain, including the multinational companies engaged in input supply, who might be supposed to rely principally on other private-sector sources of information and technology. In short, the survey results show that the benefits of the knowledge, experience, and innovation vested in the public sector are already flowing to farmers through the activities of diverse private-sector actors.

Implications for Public Policy and Research Management

This diversification and change in the sources of innovation available to farmers has important implications for policymakers and research managers.

The shift in Kenya's policy towards market liberalization has profoundly affected the environment for innovation at the farm level. The case study shows that the innovations chosen by farmers depend on a combination of the natural, economic, and institutional components of this environment. However, the innovation system appears to be evolving not just at different speeds, but also in different ways in the two districts studied.

The Kiambu dairy farmers have better access to markets and information than their counterparts in Nyandarua. They are adopting more intensive production technologies, which depend on the acquisition of both purchased inputs and the knowledge to manage them effectively. Moreover, they are more dependent on private-sector sources of innovation, while farmers in Nyandarua continue to rely on public-sector services, even though these are in decline. The reliance of producers on dairy cooperatives in Kiambu and on self-help groups in Nyandarua can be interpreted as different responses to different situations: in the former case to the growing importance of the market and in the latter to the vacuum left by the decline of public-sector support services.

It is impossible, on the basis of this survey, to be sure which of the differences observed between the two districts can be attributed to the different geographical and historical contexts of dairy farming and which genu-

inely represent different stages in the development of market-oriented production. For example, the self-help groups of Nyandarua might evolve into cooperatives if better marketing opportunities were to become available. Nevertheless, the continuing importance of the public sector as the "ultimate" source of innovation, coupled with the growing importance of private-sector actors as the immediate providers, suggests that policymakers would do well to foster stronger links between the two.

The nature of the information and technology provided by private-sector actors differs significantly from that provided by their public-sector counterparts. Private-sector actors typically provide information only on the product or service they sell, while public-sector actors tend to offer more comprehensive and objective information on a range of alternative inputs. Farmers may have difficulty in coping with the fragmentation of innovation sources that occurs once the public sector is no longer the sole provider of services. They may need to garner information and technology from several sources before they can improve their production system—and the advice they receive along the way may be partial or even contradictory. Farmers increasingly need the ability to make their own judgments and to take decisions based on their own syntheses. The public sector may thus have a key role to play in fostering farmer education and ensuring that the information available to farmers is objective.

Against a backdrop of declining public funding, the most pressing challenge facing policymakers is to

improve the infrastructure and institutions in the more remote districts and those less well endowed with natural resources, where there are few alternative service providers. This must happen if these areas are not to be virtually excluded from the processes of innovation and development.

The case study underlines the continuing value of public-sector research and of the knowledge held in public-sector institutions. It also reveals the need to develop new channels for transferring innovations to farmers through private-sector actors. In an intensive production environment such as Kiambu, there may be considerable opportunities for investors, including foreign investors, to sell new technologies to farmers. In such cases, public-sector actors may have a special role to play in ensuring that these technologies are adapted to local needs and that farmers can adopt them without undue risk.

In conclusion, the case study confirms that, when markets are liberalized, the public sector still has a vital, though changing, role to play in promoting agricultural innovation. The new economic and institutional environment fostered by liberalization offers opportunities to increase the synergy between publicly supported rural development efforts and private-sector technology transfers. Indeed, the reduced funding available to public-sector actors obliges them to exploit such opportunities. As this environment continues to evolve, public-sector actors will have less direct contact with farmers. They will need to achieve impact by working through the network of market-oriented actors that is already serving farmers in high-potential areas, while concentrating their own outreach efforts in areas where markets are developing only very slowly or are unlikely to develop satisfactorily. Research institutes will continue to be vital sources of innovation but will need to initiate new partnerships for development with diverse private-sector intermediaries in order to reach as many farmers as possible and hence to maximize the benefits of public-sector research.

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